Section 05: Midterm Review

1. Stacks and Queues

Consider a sequence of characters and the task is to reverse the sequence. Is it beneficial to use a stack or a queue to perform this task? Assume that stacks and queues are implemented using linked lists and each node in the linked list stores a character.

2. Asymptotic Analysis

For each of the following, choose a c and n_0 which show $f(n) \in \mathcal{O}(g(n))$. Explain why your values of c and n_0 work.

(a) $f(n) = 5000n^2 + 6n\sqrt{n}$ and $g(n) = n^3$

(b) $f(n) = 2^n$ and $g(n) = 3^n$

3. Recurrences

Solve these recurrences (give a Big-Theta bound). If the master theorem is applicable, state which case you used. If you use unrolling or the tree method, show your work.

(a)

$$T(n) = \begin{cases} 1 & \text{if } n = 1 \\ T(n/2) + n^2 & \text{otherwise} \end{cases}$$

(b)

$$T(n) = \begin{cases} 1 & \text{if } n = 1 \\ 2 \cdot T(n/4) + \sqrt{n} & \text{otherwise} \end{cases}$$

(c)

4. AVL/BST

Insert $\{6, 5, 4, 3, 2, 1, 10, 9, 8, 6, 7\}$ into an initially empty AVL tree.

5. Heaps

Insert $\{6, 5, 4, 3, 2, 1, 10, 9, 8, 6, 7\}$ into an initially empty min-heap. Write down the final heap as an array.

6. Hash tables

(a) Consider the following sequence of numbers.

6, 29, 41, 34, 10, 64, 50

Suppose the hash function is $h(k) = 2k$. Insert each number into the following hash tables and draw what their internal state looks like:

(i) A hash table that uses linear probing, with internal capacity 10. Do not worry about resizing.

(ii) A hash table that uses quadratic probing, with internal capacity 10. Do not worry about resizing.